MOTIUM™

MPS/100

PC/104 Power Supply Module

User Manual

Note: The power supply is supplied as shown in the photograph.
No additional heatsink is required.

Revision History

Rev	Data	Changes	DRN	CHK	APP
1	20 Oct 04	Initial release.	AW	AW	AW

Document Number: 108-04-MN-01-A

Table of Content

1. Overview

Motium's MPS/100 is a PC/104 format power supply (DC-DC converter) module. It is designed for use as:

- a mezzanine power supply module for single board computers (SBCs).
- a power supply module within a PC/104 stack.

Its wide input voltage range of 6VDC to >30VDC makes it ideal for vehicle (car, bus, truck, aircraft and marine), battery and unregulated input applications.

Its unique design results in very high efficiencies, allowing for high output currents at high ambient temperatures. For example, no fan cooling is needed at 82W output power (+12V @ 3.5A and 5V @ 8A), even at ambient temperatures of 70°C.

An important feature is that the +12V and +5V regulators are separate (independent) regulators. The +12V regulator does not take power from the +5V supply. This means that high output currents can be simultaneously supplied from the +5V and +12V outputs, without risk of the MPS/100 running too hot. DC-DC Converter Modules which regulate the input voltage to +5V and then up-convert the +5V to +12V are less efficient (typically 10% to 15% less efficient on the +12V output) and therefore, run hotter.

Input and output power connectors are designed for automotive use, with a locking mechanism, ideal for high-vibration environments (like vehicles), unlike screw terminals.

Transient and load-dump protection is provided via a 5kW transient suppressor and filter circuit on the power supply input.

A sophisticated intelligent power on / off control function is provided by an optional on-board microcontroller. Configurable functions provided include:

- Time delay between when vehicle is turned on and output power goes on.
- Time delay between when vehicle is turned off and output power goes off.
- Output power off if the vehicle’s engine is not running, and the vehicle’s battery voltage falls below a specified voltage.

Configuration is via an RS232 data port, using Motium’s configuration utility (Windows and Linux versions available). The RS232 port can also be used to collect status information from the power supply.

1.1. Intended applications

The MPS/100 was designed primarily to be integrated in equipment designed for use in vehicles: cars, trucks, busses, aircraft and boats. Its wide input voltage range, high output current, efficiency and wide operating temperature range allow it to be used in a wider variety of applications, including battery powered equipment and industrial equipment.

1.2. Ordering options

The table below lists the ordering options for the MPS/100.

Order Code	Option	Description
-I	Intelligent power on/off control	The MPS/100 can be supplied with intelligent power on/off control. This function is not fitted as standard. Minimum order quantities apply.
-C	Power Connectors	The MPS/100 is supplied standard with: • A 2-pin connector fitted in positions J3 (Input Power) and J4 (+5V output). 4-pin connectors can be fitted in these positions. • J6 (-12V) not fitted. A 2-pin connector can be fitted in this position. Minimum order quantities may apply.
-R	Reverse polarity protection	Input reverse polarity protection is not fitted as standard. It is an order option. The MPS/100 uses a MOSFET instead of a diode, resulting in: • Significant efficiency improvement. • A MOSFET removes the hot-spot caused by the power loss across a diode (typical voltage drop across a diode is 0.6V to 1V). • Has little impact on the 6VDC input range. The voltage drop across the MOSFET is typically less than 0.2V, and is directly proportional to input current.
-F	Fuse	The MPS/100 allows a PCB mount fuse to be fitted. A wire link is fitted as standard. A fuse can be supplied as an option. The customer needs to specify the fuse rating (our applications staff can provide guidance). Minimum order quantities may apply.
-nT	Vehicle transient suppressor	A 5kW transient suppressor is fitted as standard. This is for transient and load-dump protection. The transient suppressor results in a typical upper input voltage limit of 30VDC to 32VDC. The transient suppressor can be removed in non-vehicle applications.
-	Higher +12V output current	In 24V vehicle applications, where the +12V (and -12V) supply does not need to be maintained if the input voltage falls below 12V, the topology of the +12V regulator can be changed to provide high output currents, with typical efficiency of 97%.
-	No PC/104 connector	The MPS/100 can also be embedded in industrial equipment, which must be powered from +24VDC. In these applications the PC/104 connecter may not be required. The MPS/100 can be supplied without the PC/104 connector. Minimum order quantities apply.
-	OEM configurations	OEM configurations, with different performance characteristics. Minimum order quantities apply.

Table 1 MPS/100 ordering options

1.3. Features

Key features of the MPS/100 are:

- 120W PC/104 Power Supply Module.
- Very high efficiency. Up to 95%.
- 6 VDC to 36* VDC input range.
- +5V @ 14A.
- +12V @ 5A.
- -12V @ 0.5A.
- NO forced air cooling required at +5V @ 8A and +12V @ 3.5A.
- +12V is NOT derived from +5V output.
- +5V and +12V outputs short circuit protected, and automatically recover when the short circuit is removed.
- -30°C to +85°C operating range.
- Automotive connectors maximise reliability in harsh environments.
- Transient and load-dump protection.
- Intelligent power on/off control (option).

1.4. Specifications

The specifications for the MPS/100 are listed in the table below.

Regulator Performance

	+5V	+12V	-12V
Output Current**	14A maximum. 8A continuous at 70°C with no fan cooling.	5A maximum. 4A continuous at 70°C with no fan cooling.	500mA maximum. 300mA continuous.
Output Ripple	20mVp-p.	200mVp-p.	
Line Regulation	+/-1%.	+/-1%.	+/-10%.
Load Regulation	+/-1%.	+/-1%.	+/-10%.
Efficiency***	94% typical.	93% typical.	88% typical.
Overload Protection	Short circuit protected.		-

Overall

Input Voltage	6VDC to 36VDC*.
Input current	The maximum input current depends on the output power. It should be limited to 14A continuous.
Output power**	120W maximum. 82W (5V @ 8A and +12V @ 3.5A) fanless.

Environmental Characteristics

Operating Temperature	-30°C to +85°C.
Storage Temperature	-40°C to +85°C.
Humidity	10% to 90% non-condensing.

Physical Characteristics

Dimensions	PC/104 format module. Overall: 90mm (3.55") wide x 95mm (3.75") long, plus connectors. Component height: Max top side: 12mm. Max bottom side: 3mm.
Weight	115g net. 160g gross.
PC/104 Connector	Stack-through connector. Keying pins (B10 and C19) removed. Keying plugs not fitted.

Specifications are subject to change without notice.

* The input voltage range is based on no transient protection. With vehicle transient protection, the top end of the input range is 30V to 32V.

** The actual maximum available output power depends on several system factors. Refer to the MPS/100 User Manual for information on this.

*** The actual efficiency varies with input voltage. Refer to the MPS/100 User Manual for specific information on this.

Whilst the +12V regulator works with an input voltage down to 6V, it is not intended to operate for extended periods of time at 6Vin and high output current. In this situation the power supply will become very hot.

1.5. Intended audience

This manual is written for system integrators and system designers. It contains information on installation, configuration and operation of a power supply module.

2. Connectors, Links and LEDs

The figure below shows the location of the various connectors, jumpers and LEDs on the MPS/100. This chapter describes the connectors, their functions and pin assignments.

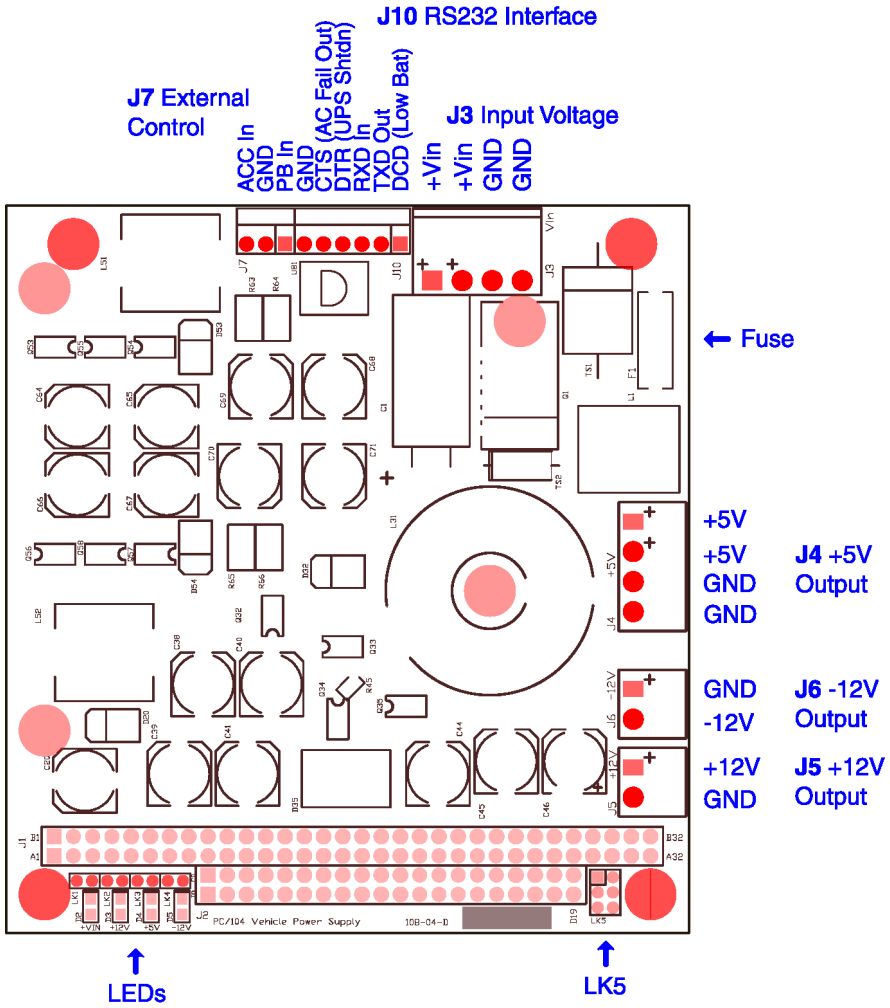

Figure 1 MPS/100 Top view, showing connector, LED and jumper positions

2.1. Connectors

There are 8 user accessible connectors:

- J1 and J2 are the PC/104 connector.
- J3 is the power input connector.
- J4, J5 and J6 are power output connectors. Output power primarily passes through the PC/104 stack. However, the MPS/100 can provide more power than the maximum current allowed to pass through the PC/104 connector pins. Typically these connectors are used to power devices that are not part of the PC/104 stack.
- J7 and J10 are used for intelligent power on/off control.
- J8 is for factory use only. The pins are near the center of the PCB. No connector is fitted in this position. Do not attach anything to the pads.

Useful information:

- Pin 1 is indicated by a square pad.
- Connector number and positive pins (+) are indicated on the top side component overlay.
- All power connectors are 2-pin or 4-pin JST B2PS-VH series; right-angle 7A/pin, crimp pin, locking type. They are readily available, including from catalog companies such as Farnell.
- J7 and J10 are Molex KK series connectors: right-angle, 0.1-inch (2.54mm) pitch, crimp pin, friction lock. They are readily available, including from catalog companies such as Farnell.

2.1.1. J1 and J2 – PC/104 connectors

J1 and J2 are the PC/104 connectors. J1 is 64-pins and J2 is 40-pins. The pin assignments are listed in the table below.

To ensure maximum compatibility with all PC/104 cards, keying pins B10 and C19, and the associated keying plugs, are not fitted (to allow cards which do not have the keying pins removed to be easily plugged into the MPS/100).

J1				J2			
Pin #	Signal	Pin #	Signal	Pin #	Signal	Pin #	Signal
A1	GND	B1	GND				
A2	nc	B2	nc				
A3	nc	B3	+5V				
A4	nc	B4	nc				
A5	nc	B5	nc				
A6	nc	B6	nc				
A7	nc	B7	-12V				
A8	nc	B8	nc				
A9	nc	B9	+12V	C0	GND	D0	GND
A10	nc	B10	Key -- no pin	C1	nc	D1	nc
A11	nc	B11	nc	C2	nc	D2	nc
A12	nc	B12	nc	C3	nc	D3	nc
A13	nc	B13	nc	C4	nc	D4	nc
A14	nc	B14	nc	C5	nc	D5	nc
A15	nc	B15	nc	C6	nc	D6	nc
A16	nc	B16	nc	C7	nc	D7	nc
A17	nc	B17	nc	C8	nc	D8	nc
A18	nc	B18	nc	C9	nc	D9	nc
A19	nc	B19	nc	C10	nc	D10	nc
A20	nc	B20	nc	C11	nc	D11	nc
A21	nc	B21	IRQ7	C12	nc	D12	nc
A22	nc	B22	IRQ6	C13	nc	D13	nc
A23	nc	B23	IRQ5	C14	nc	D14	nc
A24	nc	B24	IRQ4	C15	nc	D15	nc
A25	nc	B25	nc	C16	nc	D16	+5V
A26	nc	B26	nc	C17	nc	D17	nc
A27	nc	B27	nc	C18	nc	D18	GND
A28	nc	B28	nc	C19	Key -- no pin	D19	GND
A29	nc	B29	+5V				
A30	nc	B30	nc				
A31	nc	B31	GND				
A32	GND	B32	GND				

nc = no connect

Table 2 MPS/100 J1 and J2, pin connections

2.1.2. J3 – Input Power Connector

Power into the MPS/100 is supplied through connector J3. J3 has a maximum rating of 7A per pin. The MPS/100 can be ordered with a 2-pin or 4-pin connector fitted. The deciding factor is total output power (which determines total input power and therefore maximum input current). For operation in 24V vehicles, typically only the center two pins need to be connected.

Pin#	Signal
1	+Vin
2	+Vin
3	GND
4	GND

Table 3 J3 pin assignments

2.1.3. J4 – +5V Output Connector

+5V out of the MPS/100 is carried on the PC/104 connector (J1 and J2) and J4. The MPS/100 can be ordered with no connector or a 2-pin or 4-pin connector in this position. The deciding factor is total output power at +5V. J4 has a maximum rating of 7A per pin. A typical PC/104 connector has a maximum rating of 2A or 3A per pin (6A or 9A from the PC/104 stack). The MPS/100's PC/104 connector has a rating of 3A per pin.

Pin#	Signal
1	+5Vout
2	+5Vout
3	GND
4	GND

Table 4 J4 pin assignments

2.1.4. J5 – +12V Output Connector

+12V out of the MPS/100 is carried on the PC/104 connector (J1) and J5. The MPS/100 can be ordered with no connector or a 2-pin connector in this position. The deciding factor is total output power at +12V. J5 has a maximum rating of 7A per pin. A typical PC/104 connector has a maximum rating of 2A or 3A per pin. The MPS/100's PC/104 connector has a rating of 3A per pin.

Pin#	Signal
1	+12Vout
2	GND

Table 5 J5 pin assignments

2.1.5. J6 – -12V Output Connector

-12V out of the MPS/100 is carried on the PC/104 connector (J1) and J6. The MPS/100 can be ordered with no connector or a 2-pin connector in this position.

Pin#	Signal
1	GND
2	-12Vout

Table 6 J6 pin assignments

2.1.6. J7 – External Control Connector

J7 is only fitted with the Intelligent Power On/off Control option.

The MPS/100 is turned on and off in response to:

- An external Push Button (a momentary contact push button, wired between PB In and GND).
- The vehicle's Accessory circuit.

Both control inputs can be used at the same time. Operation and configuration of the power on/off function is described elsewhere in this manual.

Pin#	Signal
1	PB In
2	GND
3	ACC In

Table 7 J7 pin assignments

2.1.7. J10 – RS232 Interface Connector

J10 is only fitted with the Intelligent Power On/off Control option. It is an RS232 compatible serial port and is used to configure the power on/off function (described elsewhere in this manual).

Pin#	Signal
1	DCD (Low Battery)
2	TXD Out
3	RXD In
4	DTR (UPS Shutdown)
5	CTS (AC Fail Out)
6	GND

Table 8 J10 pin assignments

2.2. Indicator LEDs

Four indicator LEDs show the presence of:

- +Vin
- +12Vout
- +5Vout
- -12Vout

The LEDs show the presence or absence of a voltage. They do not indicate if the voltage is within tolerance.

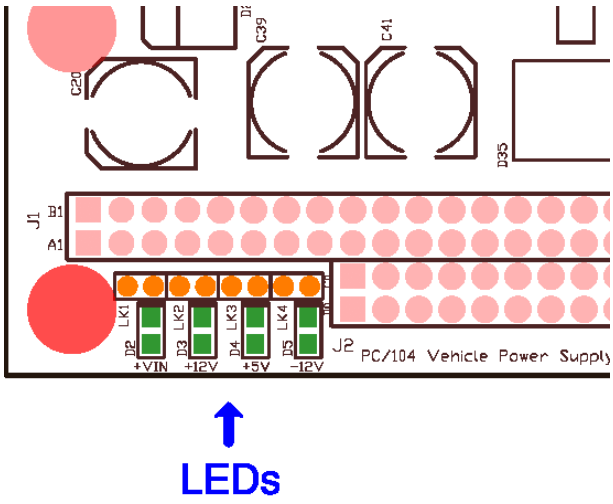

Figure 2 Location of indicator LEDs (green) and jumpers (orange)

2.2.1. Disabling the LEDs

It is possible to disable the LEDs, to reduce power consumption. The signal to each LED passes through a 2-pin, 2mm pitch jumper: LK1 for +Vin, LK2 for +12V, LK3 for +5V and LK4 for –12V. The jumper is not fitted in the factory. However, a short track, on the bottom side of the PCB, shorts the pins of each jumper.

To disable the LEDs, cut the track between the two pads of each jumper.

To enable the LED, solder a wire link between the pads, or fit a piece of 2mm-pitch header-strip and fit a jumper for each LED.

2.3. Jumper LK5

LK5 is only fitted with the Intelligent Power On/off Control option. Configuration of LK5 is described elsewhere in this manual.

3. Mechanical details

The figure below shows a top view, dimensioned mechanical drawing, of the MPS/100. Its main purpose is to identify the position of connectors.

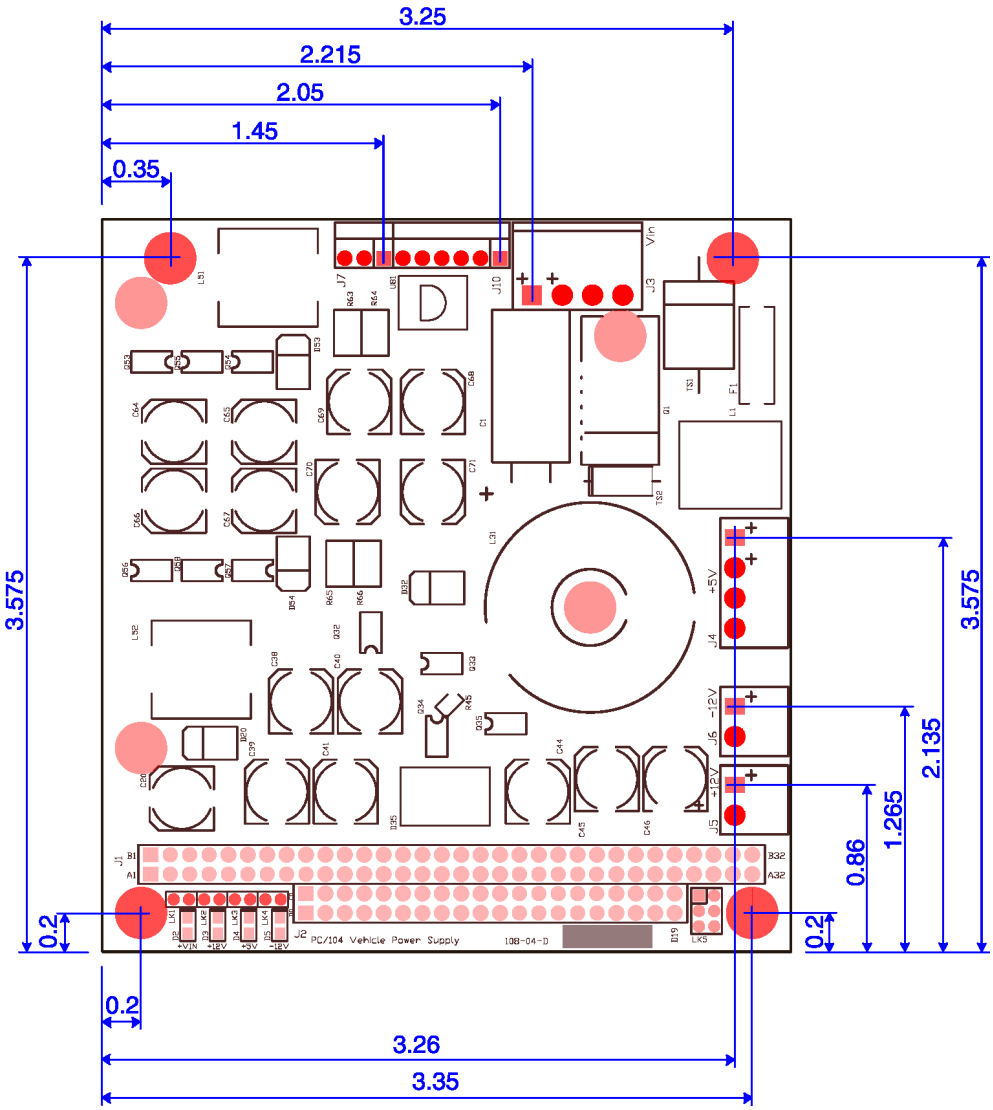

Figure 3 MPS/100 Top view, showing various dimensions (All dimensions in inches.)

4. Installation considerations

This chapter discusses issues to consider when using the MPS/100 in a system.

4.1. ESD handling precautions

Standard ESD handling precautions should be used with the MPS/100.

4.2. Installation onto PC/104 stacks

Take the usual care when plugging the MPS/100 into the female connector on a PC/104 module, to ensure that the four rows of pins mate correctly onto the four rows of sockets on the target module. Because of the number of rows in the connector, it is easy to misalign the modules when plugging them together, resulting in one row of pins hanging in air.

Prior to plugging the modules together, it is good practice to check that no pins have been bent, due to handling, on the PC/104 connector.

Keying pins B10 and C19 are not fitted on the MPS/100, ensuring the module can be readily plugged into PC/104 modules which have the keying plugs fitted in the female portion of their PC/104 connector.

4.2.1. Install at the top of the stack

Where possible, make the MPS/100 the last card in (i.e., at the top of) a PC/104 stack. This should provide the best result for convection cooling. If the system is fan cooled, ensure the air passes horizontally over the MPS/100, and that the air flow is not blocked by the PC/104 connector. Ideally, air should flow in the same orientation as the PC/104 connector, i.e., the fan should be perpendicular to the PC/104 connector.

4.3. Input voltage wiring

The system designer needs consider the gauge of wire used when connecting the MPS/100 to the voltage source, such as a vehicle's battery. At high input currents, voltage drop along the wires can be significant. Always use the largest practical wire size, to ensure minimum voltage drop across the wires.

Remember, input voltage drop is the sum of current flowing in both the Vin and GND wires. So wire resistance needs to be calculated for both the Vin and GND wires.

4.4. Reverse polarity protection

Input reverse polarity protection is not fitted as standard on the MPS/100. Depending on design requirements and system design goals, reverse polarity protection may not be necessary, or it may be more appropriate to place it elsewhere in the system, or it can be ordered as an option with the MPS/100.

The MPS/100 uses a MOSFET instead of a diode. The benefits are:

- Significant efficiency improvement. Diodes typically have a voltage drop across them of 0.6V to 1V, compared with less than 0.06V for a MOSFET. Note the voltage drop varies with input current and ambient temperature.

- A MOSFET removes the hot-spot caused by the power loss across a diode.
- A MOSFET has little impact on the performance at the low end (6VDC) of the input range.

4.5. Transient suppressor considerations

In vehicle computing applications, voltage transients are caused each time the engine is started. Transients are also caused when the vehicle is jump started, and due to *load dumps* (an energy surge caused by disconnecting the battery whilst it is being charged).

A 5kW transient protector is fitted as standard on the MPS/100. The transient suppressor results in a typical upper input voltage limit of 30VDC to 32VDC. This still provides ample headroom for 24V powered vehicles.

Depending on design requirements and system design goals, transient protection may not be necessary, or it may be more appropriate to place it elsewhere in the system. In this case the MPS/100 can be ordered without the MPS/100. (For maximum protection, the safest approach is to leave the transient suppressor fitted.)

4.6. Power supply efficiency

The two figures below show typical efficiencies for the +5V and +12V output supplies. Power supply efficiency varies with input voltage and load current. The plots do not include LED current draw or the loss if the reverse polarity protection option is fitted.

Efficiency does vary with ambient temperature, reducing at higher temperatures.

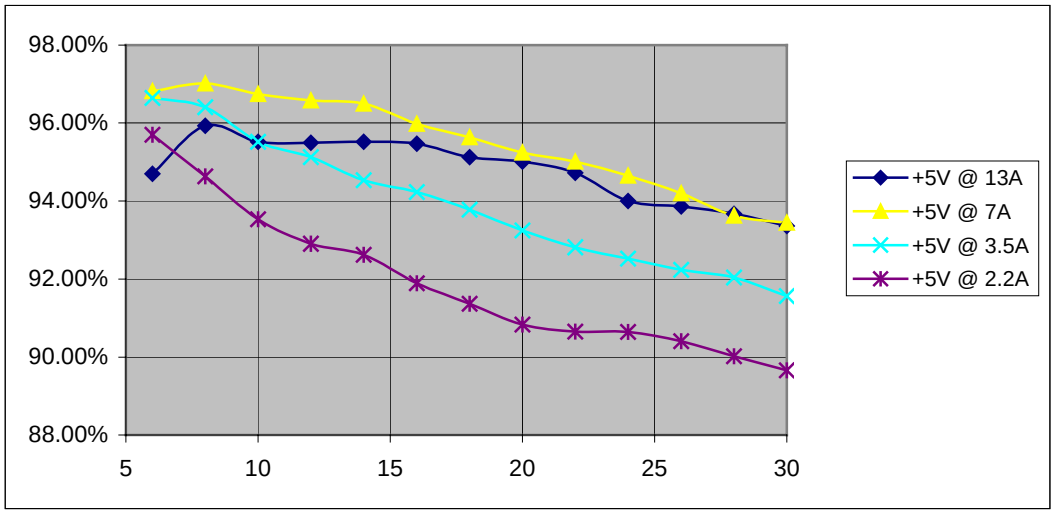

Figure 4 +5V typical efficiency curves, showing efficiency variation with input voltage and load current

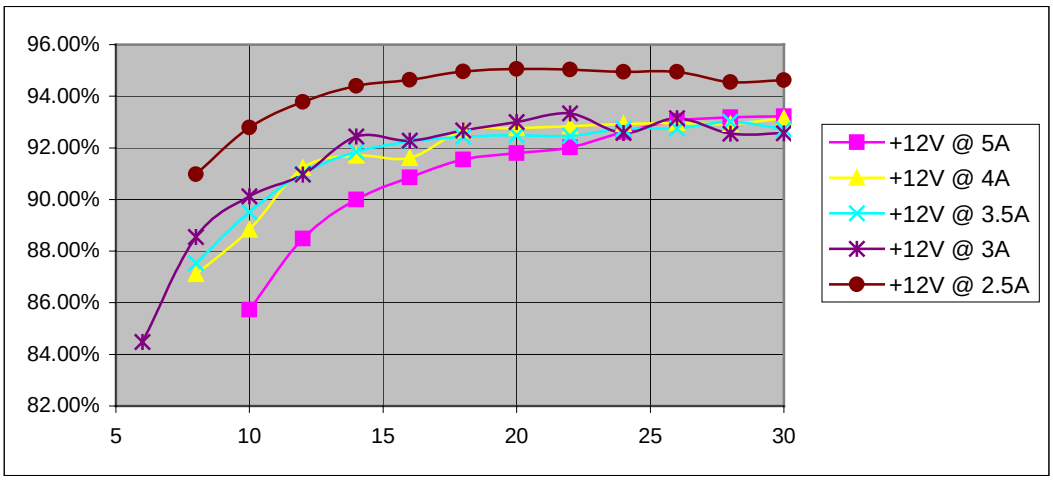

Figure 5 +12V typical efficiency curves, showing efficiency variation with input voltage and load current

An order option for the MPS/100 is for a +12V output with a typical efficiency of 94% (across the input range). This is only available where +12V is not required for input voltages below 12.4V in.

4.7. Input fuse considerations

The MPS/100 allows a PCB mount fuse to be fitted. A wire link is fitted as standard. Depending on design requirements and system design goals, a fuse may not be necessary, or it may be more appropriate to place it elsewhere in the system, or it can be ordered as an option with the MPS/100. The customer needs to specify the fuse rating (our applications engineer can provide guidance).

Things to consider during fuse selection are:

- Slow blow vs fast blow.
- Maximum input current – at the input voltage range. The higher the input voltage, the lower the input current.

  Typical operational input voltage ranges, in vehicle applications are:

12VDC	11.5V to 14.8V
24VDC	18V to 27V

- Input current during the time the voltage drops during engine start.

5. Intelligent power on / off control

Currently this section is only available on request, by customers who order the Intelligent Power On/off option.